National Aeronautics and Space Administration

DellingrX:

SmallSat Architecture and Platform Enabling Planetary Science

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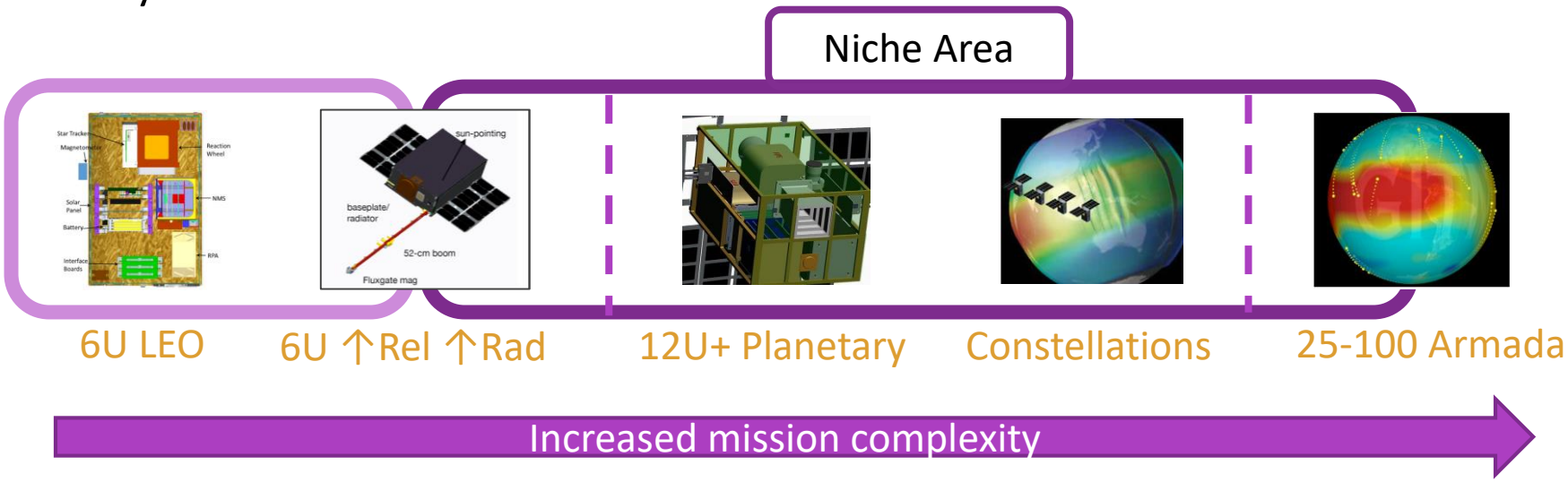
DellingrX - Introduction

Spacecraft bus architecture designed for reliability and harsh environments

- Enables challenging and harsh environment mission architectures being proposed by our scientists, especially planetary missions
- Tailors balancing/scaling of programmatic and technical risks for Class-D missions
- Reduces SWaP while increasing flexibility and robustness by integrating electronics and software for core subsystems

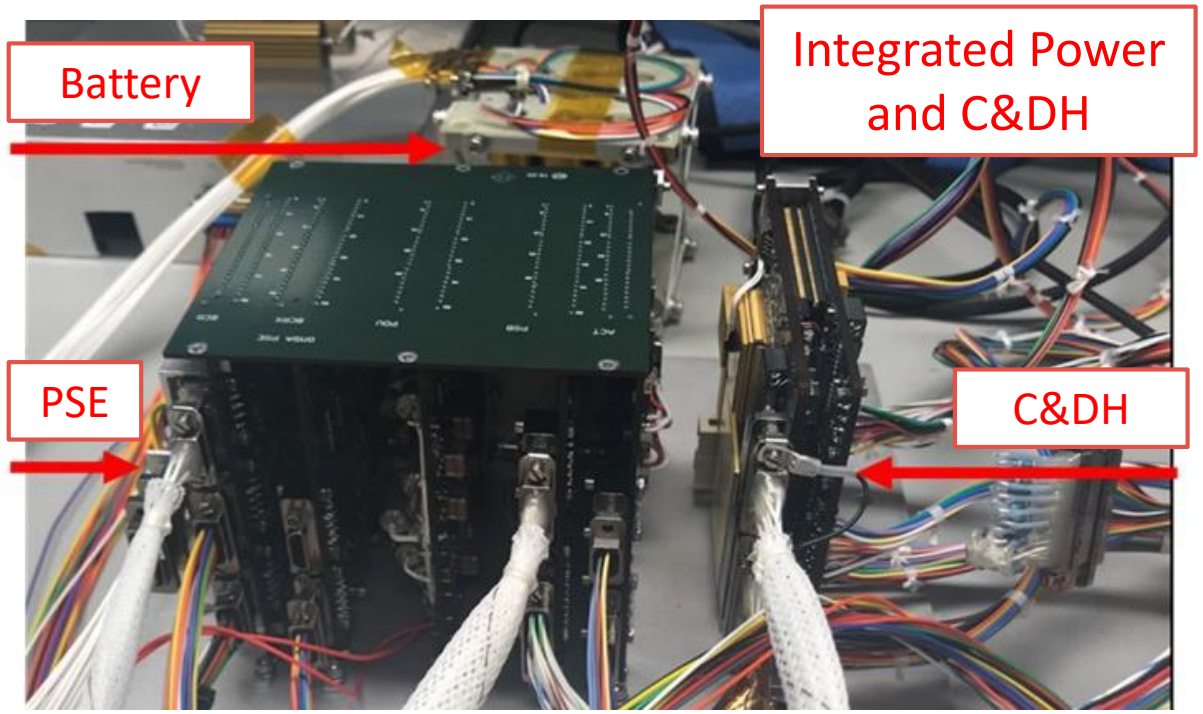


DellingrX – Targeted Capabilities

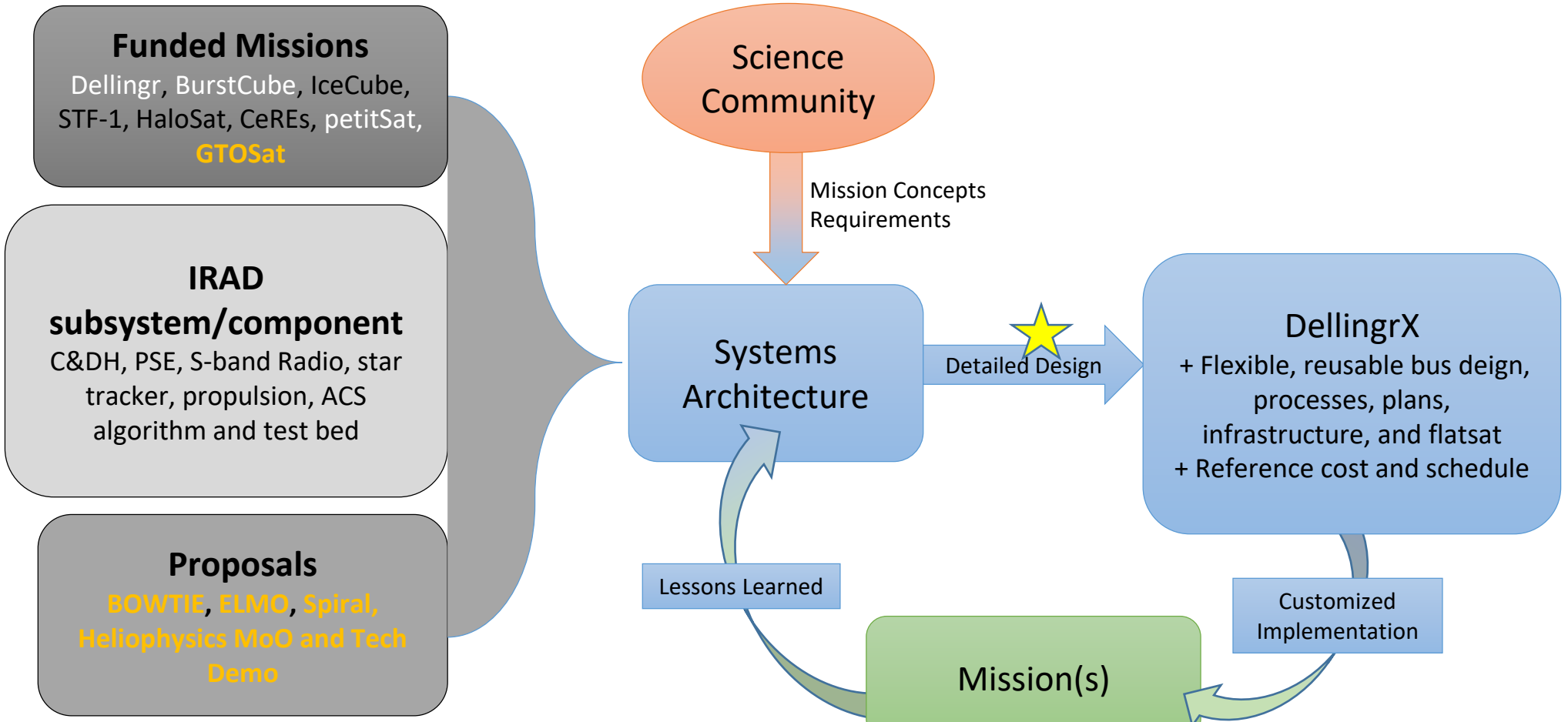
- Systems
  - Tailored Class D approach, specifically for SM&A, parts selection, GOLD rules, design margins, and testing
  - Radiation tolerance understood for each component especially for those performing critical functions
    - No destructive SEE < 37MeV/cm^2, piece part minimum TID > 30krad, system TID with part upgrades and shielding >100krad
    - Other SEE monitored and mitigated (frequency is orbit dependent but analyzable and below typical nuisance threshold)
  - Robust fault tolerance increasing overall system resiliency and enabling graceful degradation
- Mechanical and thermal – expect to customize design for every mission to cover uniques
- Communications – compatible with the IRIS radio; also developing S-band software defined radio for use with NEN and SN
- GNC
  - Navigation – IRIS transponder or optical navigation (in development)
  - Propulsion – compatible with most of the mature prop in a box solutions
  - ADCS
    - Pointing knowledge - .005 deg (18 arcsec) (1sgima); quaternion at > 4Hz; pointing accuracy - < 1 deg
    - Autonomous protection of predefined exclusion/keep out zones

DellingrX – Targeted Capabilities

- Power
  - 50W – 250W input power @ 1AU, BOL, 85% efficient
  - Secondary voltages +12V (3A), +5V (5A), +3.3V(3A), unregulated bus ~+12V or +28V (10A)
  - Configurable distribution with 8 switched outputs (4 latching current limited) scalable to 16
  - Watchdogs, commandable reset
- C&DH
  - Softcore LEON3 FT in an RTG4 FPGA (performance benchmark available)
  - 10MB SRAM, 250KB MRAM, 4GB Flash
  - Optional High Performance Processing node add-on
  - Running cFE/cFS
  - Many digital, analog, actuator, and telemetry interfaces (usually covers all the standard components)
  - Supervisory monitors and watchdogs



Leveraging Institutional Investment



DellingrX Precursor Based

DellingrX - Development Status and Schedule

- DellingrX Systems Engineering Working Group
  - Established fall 2017 and has expanded to include engineers working studies and proposals
  - Surveyed the 4 science communities to gather typical/common mission requirements
  - Presented preliminary high level design to the 4 science communities
  - Held 2-day design “retreat” with subsystem and discipline engineering experts
  - Designed tiered approach for system functional reliability, reducing cost of non-critical components
  - Identified trade studies and capabilities gaps
  - Baselined communications architecture
  - Testing performance and reliability of several ADCS components for infusion in the baseline

- Future High Level Milestones
  - Requirements review: 10/2018
  - Core subsystems detailed design culminating in table top reviews: 10/2018 – 4/2019
  - Preliminary cost and schedule completed – 5/19
  - FlatSat with key components available – 7/19
  - Bus level integrated testing (medium fidelity form, fit, function) with available core components (TRL 5) – 9/2019

Contacts and Acronyms

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ACS – Attitude Control System
AETD - Applied Engineering & Technology Directorate
AU – Astronomical Unit
BOWTIE – Bubbles Observed Within The IonospherE
C&DH – Command and Data Handling
CeREs – Compact Radiation Belt Explorer
cFE/cFS – core Flight Executive/core Flight Software
COTS – Commercial Off the Shelf
FPGA – Field Programmable Gate Array
GN&C – Guidance, Navigation, & Control
GPS – Global Positioning System
GSFC – Goddard Space Flight Center
GTO – Geostationary Transfer Orbit
LEO – Low Earth Orbit
PSE – Power Supply Electronics
RWA – Reaction Wheel Assembly
SEE – Single Event Effects
SSPO – Small Satellite Project Office
STF-1 – Simulation To Flight 1
TRL – Technology Readiness Level